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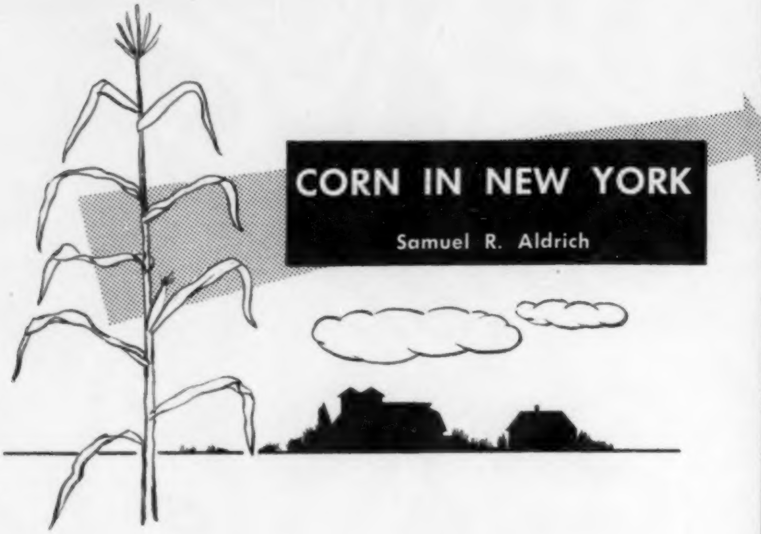
New York State College of Agriculture

CORN IN NEW YORK

By Samuel R. Aldrich



CORN IN NEW YORK

Samuel R. Aldrich

CONTENTS

Corn is the third ranking crop in acres in New York. Since 1866 the acreage has varied from a low of 550,000 in 1930 to a high of 845,000 in 1900, and has fallen below 600,000 only once since 1932 (figure 1 and table 1).

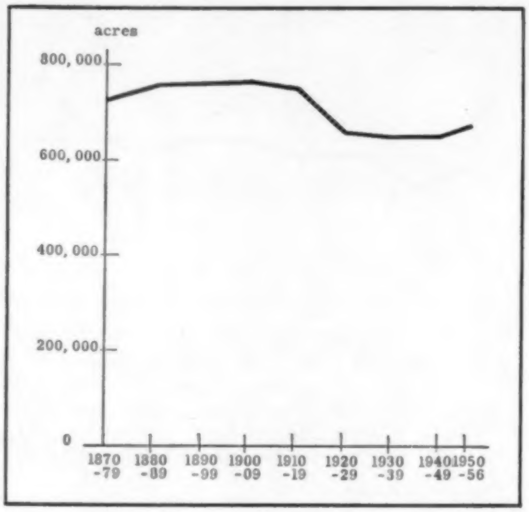


Figure 1. Acres of corn in New York, 1870–1956. N. Y. State Dept. of Agric. and Markets.[1]

[1]See footnote at bottom of table 1 for source of data.

Table 1. Acres of corn harvested in New York, 1870-1956 N. Y. State Department of Agriculture and Markets[1]

Year or Period	All Corn	Silage	Forage	Grain
	1,000 A.	1,000 A.	1,000 A.	1,000 A.
1870–79	725			725
1880–89	754			754
1890–99	759			759
1900–09	768			768
1910–19	754			754
1920–29	664	342[2]	129[2]	192[2]
1930–34	622	377	102	143
1935–39	684	439	72	173
1940–44	675	451	76	149
1945	657	460	67	130
1946	664	465	46	153
1947	598	436	27	135
1948	634	445	25	164
1949	647	452	25	170
1945–49	640	452	38	150
1950	666	456	25	185
1951	639	447	20	172
1952	645	414	16	215
1953	664	422	20	222
1954	704	464	21	219
1950–54	664	441	20	206
1955	718	466	19	233
1956	696	443	22	231
1955–56	707	454		232

[1]Data 1870–1920 from Bulletin 264, 1932; 1920–1953 from R.M.A. Release No. 16, 1955; since 1953 from annual summaries.
[2]1924 to 1929 only.

In the 1954 census the value of the corn crop exceeded the combined value of all other grain crops: wheat, oats, barley, rye, buckwheat, and soybeans (table 2). The value of the corn crop exceeded

Table 2. Value of selected crops in New York, 1954, census data

Hay	$122,000,000
Corn	51,444,000
Wheat	22,308,000
Oats	19,227,000
Barley	1,024,000
Mixed grains	2,452,000
Buckwheat	700,700
Fruit	48,655,000
Vegetables	35,200,000
Potatoes	33,179,000

all vegetable crops by nearly 50 percent, and was slightly above all fruits. Corn was second in value only to the hay crop.

New York ranks high in acres of corn compared to neighboring states, but low relative to the important Corn Belt states (table 3).

Table 3. Acres of corn in New York compared to adjacent states and Corn Belt states, 1956, U.S.D.A.

Northeast States		Corn Belt States	
Pennsylvania	1,281,000	Iowa	10,229,000
New York	**696,000**	Illinois	8,804,000
New Jersey	188,000	Minnesota	5,734,000
Vermont	59,000	Nebraska	5,312,000
Connecticut	39,000	Indiana	4,783,000
Massachusetts	28,000	Ohio	3,595,000

The utilization of the corn crop has changed markedly through the years. Before about 1880 all of the corn was harvested for grain, for fodder, or hogged off because there were no silos. Since 1924 the State Department of Agriculture and Markets has separated corn acreage into that harvested for silage, grain, and "forage" (table 4).

Table 4. Form in which corn was harvested in New York

Period	Silage	Grain	Forage
1924	55%	26%	19%
1935–39	64	25	11
1945–49	71	23	6
1952–56	64	33	3

The amount harvested as "forage" (hogged down, grazed, dry fodder) has declined sharply. The proportion harvested for grain increased from about one-fourth of the crop in 1924 to one-third in the most recent 5-year period. Some reasons for the changes are discussed in the following section on changing economic factors.

CHANGING ECONOMIC FACTORS

TRENDS IN YIELDS AND PRODUCTION. The average acre yield of corn changed little from 1870 through 1944 (figure 2 and table 5). Since 1944 the state average yield of corn for grain has risen about 30 percent. This increase was brought about mainly by the introduction of hybrid corn, more fertilizer (especially nitrogen), better weed control, and more timely operations because of more power on farms. This increase in terms of the 1954 crop has a gross value of about $15,000,000 annually when applied to the entire corn acreage.

The increase in acre yield of silage, about 9 percent since 1940, is less spectacular largely because it does not credit the improvement in quality. It is estimated that the corn hybrids grown for silage in 1957 average 10 to 14 days earlier in maturity than those grown in 1940. Those working closely with corn hybrids estimate that growing earlier hybrids with higher grain potential have added 2,000,000 bushels of grain equivalent in silage harvested in New York.

The increase in acre yield combined with the increase in acres resulted in grain corn production in 1955 and 1956 which was more than twice as great as in the 1940–44 period.

Until some new production factor comes into the picture, total corn acreage and the proportion harvested for grain is expected to remain near the 1955–56 level.

EFFICIENCY IN CORN GROWING. New York farmers have increased their efficiency in growing corn for grain more than any other field crop in recent years (table 6 and figure 3). The hours per

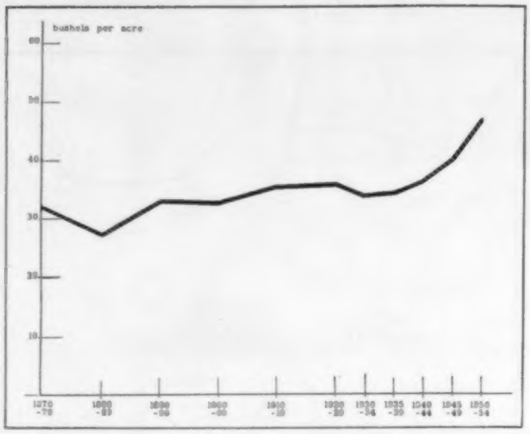


Figure 2. Acre yields of grain corn in New York, 1870–1954. N. Y. State Dept. of Agric. and Markets.[1] Prior to 1924, the data are for grain equivalent of all corn.

[1]See footnote on table 1 for source.

Table 5. Acre yield of corn in New York, 1870-1956 N. Y. State Department of Agriculture and Markets[1]

Year or Period	Corn Silage	Corn for Grain[2]
	Tons	Bushels
1870–79		31.8
1880–89		27.4
1890–99		33.0
1900–09		32.7
1910–19		35.6
1920–29		35.8
1930–34	9.36	33.9
1935–39	9.28	34.5
1940–44	9.14	36.3
1945	8.4	35.0
1946	9.3	40.0
1947	8.4	35.0
1948	10.0	44.00
1949	10.0	46.0
1945–49	9.22	40.0
1950	10.0	45.0
1951	9.9	46.0
1952	10.5	49.0
1953	10.0	48.0
1954	9.2	44.0
1950–54	9.92	46.4
1955	9.6	45.0
1956	9.8	53.0

[1]Data from 1870–1920 from Bul. 264, 1932; from 1920–1953 from R.M.A. Release No. 16, 1955; since 1953 from annual summaries.
[2]Reported as "grain equivalent" for all corn until 1924.

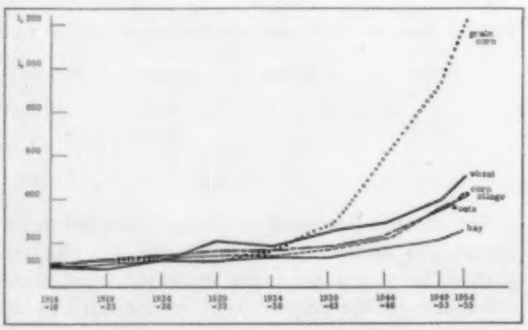


Figure 3. Index of changes in production of field crops per hour of labor, 1914 to 1955. 1914–1918 = 100. New York Cost Account Farms.

Table 6. Hours per acre and amount produced per hour of labor in selected field crops, 1914-1955. N. Y. Cost Account Farms

Period	Hay[1]		Corn silage		Grain corn		Wheat		Oats	
	Hours per acre	Tons per hour	Hours per acre	Tons per hour	Hours per acre	Bushels per hour	Hours per acre	Bushels per hour	Hours per acre	Bushels per hour
1914–18	10	0.15	37	.16	66	0.42	25	0.96	23	1.53
1919–23	11	0.14	39	.20	66	0.54	23	0.99	21	1.51
1924–28	9	0.18	36	.23	57	0.56	19	1.19	20	2.09
1929–33	9	0.19	33	.27	64	0.50	14	1.91	15	2.16
1934–38	8	0.20	34	.27	50	0.70	15	1.79	15	2.22
1939–43	8	0.21	29	.31	33	1.22	11	2.47	13	2.63
1944–48	8	0.26	23	.39	15	2.53	11	2.79	11	3.45
1949–53	6	0.32	18	.57	13	3.94	9	3.80	8	5.56
1954–55	6	0.37	13.5	.67	10	5.00	8	4.75	6.5	6.31

[1]Hay *other than alfalfa* from 1915 to 1948. Includes alfalfa 1949–55.

acre have declined from 66 to 10. The amount produced per hour of labor has increased from 0.42 bushels to 5.0 bushels, an 11-fold increase, due to higher acre yields and less hours per acre.

Most of the improvement has been made since 1940 when hybrid corn, better planters, and commercial corn pickers began to appear on New York farms. The number of pickers reported by the census on farms in 1949 was 1,822 and in 1954, 4,766. The proportion planted with corn hybrids was:

Year	%	Year	%	Year	%
1940	13.1	1945	40.6	1950	82.0
1941	17.8	1946	58.0	1951	84.5
1942	22.7	1947	69.0	1952	87.5
1943	30.1	1948	78.0	1953	89.0
1944	31.5	1949	78.5		

The increase in production of corn silage per hour of labor ranks about with that made in wheat and oats, and far ahead of that in hay.

Since field crops in New York are grown primarily for livestock feed, another useful measure of efficiency in production is the cost to grow digestible nutrients (table 7 and figure 4). The actual cost, as

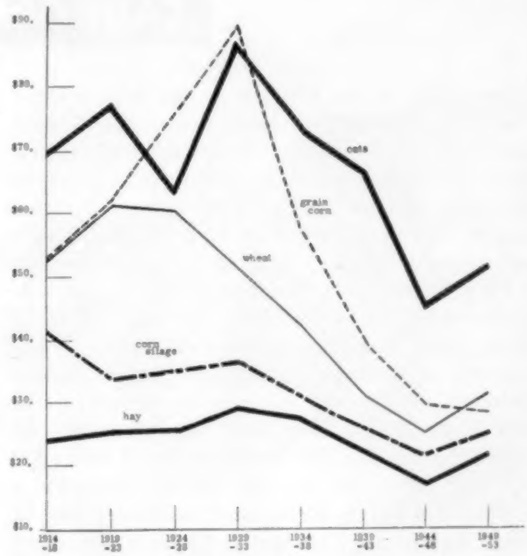


Figure 4. Changes in cost to grow one ton of Total Digestible Nutrients in Field Crops, 1914–1953. Data are for actual costs adjusted for changes in New York farm prices since 1914–1918. New York Farm Cost Account data.

Table 7. Cost to produce one ton of digestible nutrients, 1914-1953. A. E. 984, Forty Years of FARM COST ACCOUNTS

Period	Hay[1]		Corn silage		Corn grain		Wheat		Oats		Barley	
	Actual	Adjusted[2]	Actual	Adjusted[2]	Actual	Adjusted[2]	Actual	Adjusted[2]	Actual	Adjusted[2]	Actual	Adjusted[2]
1914–18	$24	$24	$41	$41	$53	$53	$53	$53	$69	$69	$69	$69
1919–23	32	25.20	43	33.86	79	62.20	78	61.42	97	76.38	85	66.93
1924–28	28	25.23	39	35.14	83	74.77	67	60.36	70	63.06	60	54.05
1929–33	24	28.57	31	36.90	75	89.29	43	51.19	72	85.71	54	64.29
1934–38	21	26.92	24	30.77	45	57.69	33	42.31	57	73.08	47	60.26
1939–43	22	22	26	26	40	40	31	31	66	66	59	59
1944–48	30	16.57	39	21.55	54	29.83	45	24.86	85	46.96	77	42.54
1949–53	39	21.20	46	25.00	52	28.26	56	30.43	94	51.09		

[1]Prior to 1949 the data were calculated from records on alfalfa and other hay reported separately.
[2]The cost figures in the "Adjusted" columns were obtained by dividing the actual costs by the index of New York farm prices using 1914–1918 as the base period. This adjustment was made in order to show real changes in costs as distinguished from changes due to the general price level. The index of Farm Prices from 1914–18 to 1949–53 was: 100, 127, 111, 84, 78, 100, 181, 184.

well as adjusted cost of growing digestible nutrients in corn for grain decreased. The unadjusted cost to grow corn silage increased slightly, oats moderately, and hay most of all.

While it is true that hay, on the basis of the accounting system used, remains the lowest cost source of nutrients, the competitive position of these major feed crops has changed drastically in the past 40 years. This partially explains why the acreage of hay has declined about 35 percent whereas corn acreage is down only 7 percent.

The introduction of large scale machinery for corn growing, 4-row planters and cultivators, and corn pickers, has placed the farmer with a small grain corn acreage at a severe disadvantage. He is forced to have his crop custom picked or to stop growing grain corn. In the 5-year period from 1949 to 1954 the amount of grain corn per farm that reported growing it changed from 5.6 to 10.0 acres, an increase of 80 percent. The number of farms reporting grain corn declined from 29,021 to 23,329. Individual counties show a more rapid shift. Onondaga County, for example, reported 16 percent more acres on 35 percent fewer farms.

CASH GRAIN FARMING

Beginning in the 1940's there has been a trend toward specialized cash grain farms, mainly corn and wheat in the Ontario Plain region of Central New York from Syracuse to Buffalo. The economic feasibility of growing grain corn in New York for sale or feed in competition with the major cash grain area of the Corn Belt has been questioned.

Four factors favor the Corn Belt: higher acre yield, lower cost of fertilizer, more efficient use of labor and machinery, and lower drying cost. Yield on well adapted soils and with good agronomic practices will average perhaps 15 bushels to the acre higher in the Corn Belt. Figured at 1956–57 prices this is about $20. Fertilizer cost is about $10 per acre less in the midwest, but the difference is rapidly decreasing. Labor and machinery can be used slightly more efficiently. Grain is less likely to be high in moisture at harvest.

Two factors favor New York, lower investment in land and higher price for the corn. Assuming a land value of $250 per acre in New York and $500 in Illinois, the difference in interest on the investment at 5 percent is $12.50 per acre each year. If the principal is paid off in 40 years, there is an additional charge of $6.25 per acre each year for the Corn Belt. The two total $18.75. Market corn in New York does not enjoy the full margin of the cost of transportation from the Corn Belt, but the cash price advantage to New York farmers in 1956–57 was at least $10 per ton. Good production methods will produce 1¾ tons per acre, which means an advantage of $17.50 per acre.

The balance shows $30 per acre for the Corn Belt for yield and fertilizer plus increased efficiency in labor and machinery against $36.25 in New York for lower land charge and higher price for the corn. Some charge should likely be made for additional cost of drying high moisture corn in New York, although drying is not the usual practice.

This rough comparison indicates that *some farmers* in New York *with favorable soils, growing season,* and *sufficient acreage* to support modern machinery *can effectively compete* with Corn Belt farmers in growing corn for grain.

WHERE CORN IS GROWN

Corn is grown throughout New York except for the Adirondack and Catskill mountain areas, the Tug Hill plateau in Lewis County, and the rough, unglaciated area in southern Cattaraugus County (figure 5). At the higher elevations (figure 6) and in all of northern New York, the crop is largely harvested for silage. Grain corn production is to an increasing extent centered in the low elevation, Ontario Plain area of central and western New York (figure 7). Table 8 shows the acres of all corn and corn for grain by counties in 1939 and 1954 as reported by the census.

Corn for grain is becoming increasingly specialized on farms that have a favorable growing season, rather easily worked soils, and a grain farming system where the corn acreage is large enough to sup-

Table 8. Total acres and acres of grain corn by counties reported by the Census of Agriculture for 1939 and 1954

County	All corn		Corn for grain	
	1939	1954	1939	1954
	Acres	Acres	Acres	Acres
Albany	7,195	5,669	1,867	1,813
Allegany	9,265	9,033	845	1,706
Broome	8,513	7,862	731	563
Cattaraugus	15,416	15,213	1,948	2,686
Cayuga	25,583	37,873	12,103	23,788
Chautauqua	20,956	17,033	6,751	3,944
Chemung	7,126	6,131	2,237	1,542
Chenango	13,681	12,535	1,532	1,531
Clinton	8,217	10,202	730	145
Columbia	13,744	14,706	5,198	5,439
Cortland	9,618	10,776	678	1,172
Delaware	8,896	8,135	570	128
Dutchess	16,396	15,805	4,044	5,089
Erie	24,931	20,948	6,864	7,284
Essex	3,561	2,779	777	27
Franklin	8,036	4,942	807	61
Fulton	467	3,872	933	170
Genesee	13,059	24,497	4,554	14,692
Greene	4,613	3,231	1,754	748
Herkimer	13,701	11,978	1,329	649
Jefferson	20,787	18,580	1,825	1,253
Lewis	6,583	5,775	320	100
Livingston	14,143	25,979	3,344	12,425
Madison	20,120	22,868	3,449	4,309
Monroe	19,337	25,148	8,388	14,404
Montgomery	15,080	13,650	2,017	991
Nassau	250	155	154	97
Niagara	19,323	23,580	10,692	17,472
Oneida	26,255	26,156	3,396	3,269
Onondaga	28,012	28,782	9,177	11,517
Ontario	15,316	24,853	9,129	13,803
Orange	13,487	13,915	2,493	1,395
Orleans	10,410	20,643	6,752	15,376
Oswego	18,155	14,454	5,261	3,628
Otsego	16,329	15,750	2,588	1,027
Putnam	1,750	890	206	89
Rensselaer	13,139	12,261	5,315	4,626
Rockland	579	243	81	82
St. Lawrence	26,369	16,673	1,141	360
Saratoga	12,849	9,988	3,918	2,494
Schenectady	3,341	1,869	629	205
Schoharie	10,789	9,185	1,171	2,212
Schuyler	4,197	4,706	2,180	1,881
Seneca	9,155	12,208	5,307	8,072
Steuben	18,220	14,461	2,914	2,165
Suffolk	3,318	2,201	1,275	787
Sullivan	4,940	2,200	956	97
Tioga	10,033	10,402	1,564	1,535
Tompkins	9,505	13,555	3,235	6,447
Ulster	8,870	7,072	3,565	2,850
Warren	1,278	613	409	39
Washington	22,442	20,597	8,032	3,580
Wayne	19,905	20,640	13,129	12,729
Westchester	1,582	582	330	38
Wyoming	12,030	17,707	1,403	5,027
Yates	8,278	10,030	5,265	5,147
	683,644	712,693	187,613	234,722

port large equipment for growing and harvesting. The introduction of picker-shellers and farm drying systems will further encourage the larger growers. The ten counties starting just east of Syracuse and extending to Niagara Falls show a marked increase

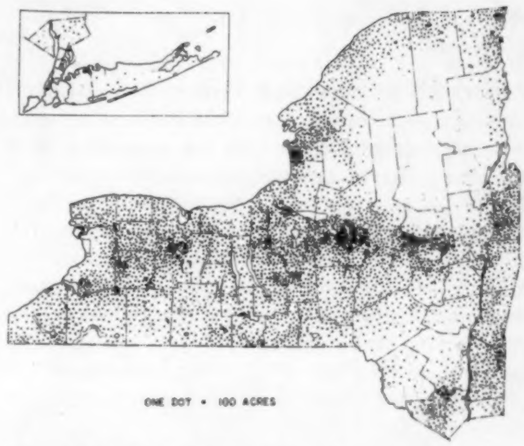


Figure 5. Distribution of corn grown for silage. Data from Census of Agriculture.

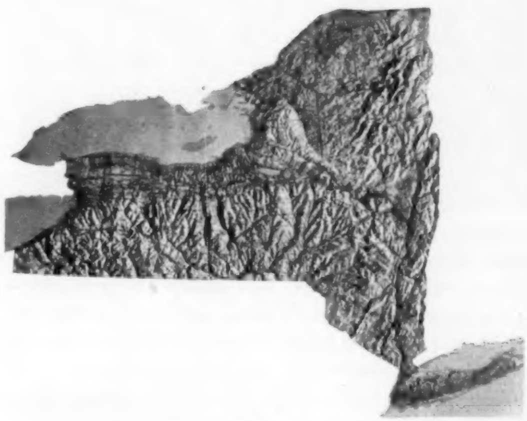


Figure 6. Relief Map of New York.

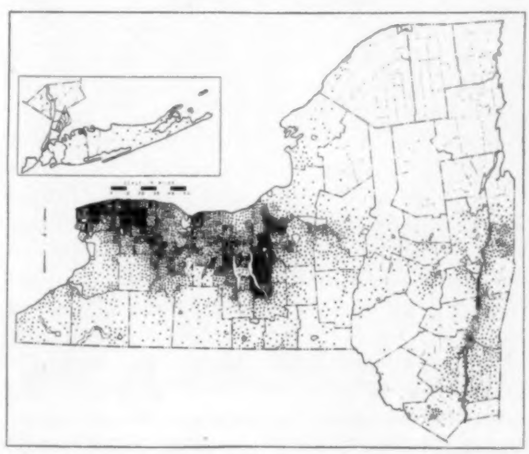


Figure 7. Distribution of grain corn in New York, 1954.

(figure 8), whereas other areas show a decline in grain corn.

CLIMATE FAVORABLE FOR CORN. In terms of New York summers, corn is a warm weather crop. The highest grain yields and the corn silage with the best grain content are grown in the areas with the longest growing season (figure 9), the lowest elevations (figure 6) and the warmest summer temperatures (figure 10). The amount of sunshine may also have an effect beyond its influence on temperature. Sunshine during the growing season is lowest near Binghamton in south central New York (52% of possible) and highest (64%) along Lake Ontario in the northwestern part of the state and in the lower Hudson Valley (62%).

Latitude, north and south, influences corn in three ways. First, favorable soil and air temperatures for planting corn are reached at low elevations in southeastern New York about 2 to 3 weeks earlier than in the St. Lawrence valley. Second, the summer temperatures are higher and corn grows somewhat faster. Third, the first killing frost in the fall comes 2 to 3 weeks later.

In New York the difference in effective growing season from the lowest to the highest elevation in farmed land is as significant for corn as the 275 miles north to south. The practical limit for grain corn in the state is about 1,600 feet elevation; for silage corn about 2,100 feet above sea level. New York farms range from about sea level along the Hudson River and Long Island to 2,300 feet around the Catskill Mountains and in southwestern New York. In the hill-valley region of southern New York many farmers in the valley can consistently mature corn for grain whereas their neighbors only a mile or two away on the hilltop find it difficult to produce well-eared silage. Another factor besides elevation that is often important is that the valley farmer has better drained soil and can regularly plant one to two weeks earlier.

Farmers usually select corn hybrids for grain or silage that nearly utilize the entire growing season. The margin of safety is much greater in regions with a frost-free period of 170 to 180 days (figure 9) than where the season is 120 to 130 days. Corn for silage can be extended to the marginal areas because if it fails to reach the desired stage of growth, it can still be ensiled without difficulty. If grain corn is killed by an early frost when the moisture in the grain is 45 to 50 percent, it may never dry enough to be safely stored as ear corn. Unless a farmer has the option of making silage, the crop may be nearly worthless.

Figure 8. Change in acreage of grain corn in four regions of New York, from 1939 to 1954.

Figure 9. Average length of growing season in days. The variation is from 90 days in part of the Adirondack Mountain area to 210 days on part of Long Island.

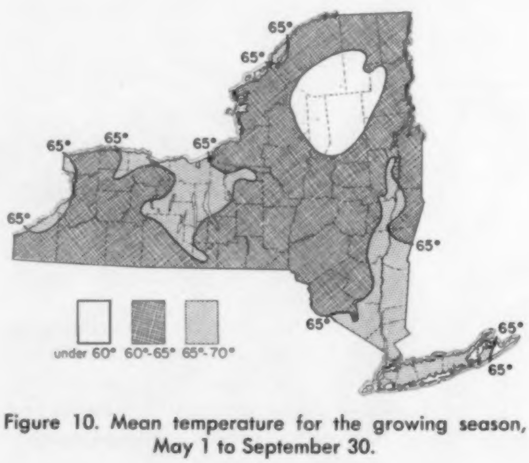


Figure 10. Mean temperature for the growing season, May 1 to September 30.

SOILS ADAPTATION. Corn is best suited to well-drained and moderately drained soils. It will grow on somewhat poorly drained soils but a farmer often has difficulty in planting on time, cultivating at the ideal time to kill weeds, and in harvesting in the fall. A farmer in an area with a relatively long effective growing season can risk planting corn on soils that would be slightly too wet to consider at high elevations and in northern New York.

On well-drained soils corn has a deeper root system than small grains, beans, and grass meadows though not so deep as perennial legumes. Corn will, therefore, tolerate more than moderate drouth. On very drouthy sites alfalfa and birdsfoot will outyield corn because the main growth is made early in the season on soil moisture reserves stored in winter and early spring. The most rapid corn growth is made in mid- to late summer when drouth is most common.

In comparison with other field crops, corn is intermediate in sensitivity to acid soil. Corn yields are, however, much higher on well-limed soils than on more acid soils because of the difference in residual effect of the legume. A near-neutral soil produces better legumes which, in turn, produces better corn following the sod crop. On acid soils corn frequently produces a higher cash return for a good liming program than other crops in the rotation. In addition to the indirect benefit through the legume crop, there is a direct effect. Liming on acid soil from pH 5.0 to 6.5 speeds up the decay of soil organic matter which releases nitrogen and phosphorus. It also makes more phosphorus available by reducing the amount of soil and fertilizer phosphorus that is tied up in insoluble forms.

A few cases of corn failures on extremely acid soils, pH 4.8 or lower, have been observed (figure 11). The plants are severely stunted. There are light-colored streaks through the leaves. The leaves may later become reddish purple as the food manufactured in the leaves is not moved to other parts of the plant.

Corn, like other row crops, responds well to a high soil organic matter content. This is because corn grows during the warm part of the year when soil organic matter is decayed at the most rapid rate. Furthermore, stirring the soil by plowing, harrowing, and cultivating introduces air and encourages the growth of soil microorganisms that decay plant residues.

The amount of corn and the methods used in growing it should be adjusted for the likelihood of erosion. On level, well-drained soils there is no erosion problem. On sloping fields a farmer has several choices to reduce soil loss:

1. Grow corn less frequently in the rotation. Corn following a sod crop will suffer much less erosion than corn following a row crop.
2. Plant on the contour rather than up and down the slope (figure 12).
3. Plant in contour strips and vary the width of strips according to the susceptibility of the soil to erosion.

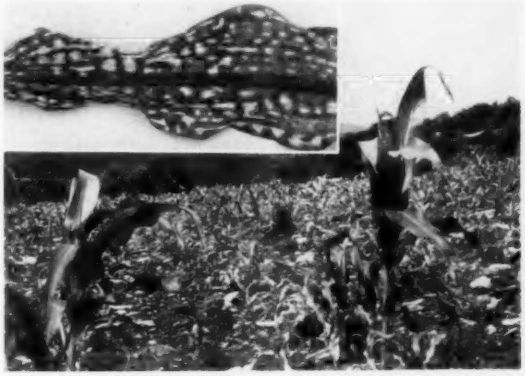


Figure 11. Corn on extremely acid soils makes poor showing. The plants are severely stunted with light-colored streaks and dead spots on the leaves.

Figure 12. Corn rows up and down the slope invite trouble from erosion. Contour strips of varying width, depending upon slope are desirable.

4. Practice minimum tillage (figure 13) which leaves the surface rough and open.
5. Plant a cover crop to reduce soil loss in the fall, winter, and spring after the corn is harvested. This cannot be done where a farmer feels that it is necessary to fall plow in order to get spring grains planted on time.

Figure 13. Right, erosion can be reduced by practicing minimum tillage. The soil surface is rough and open.

ROTATIONS

The easier a soil is to plow, fit, plant, and cultivate, the more often corn may be considered in the rotation. Some farmers (figure 14) have found that on silt loams and gravelly loams they can grow corn for many years if they fertilize liberally, plant a cover crop to maintain tilth, and don't work and cultivate the soil more than is necessary.

Most farmers should grow corn in rotation with other crops *but there is one special situation where corn year after year should be considered.* On a combination hill-valley farm the near-level, non-erosive fields are *best kept in corn most of the time* and treated liberally with manure and fertilizer (figure 15). Maintaining good tilth is usually not a problem because these soils are likely to be gravelly loams. Corn should be grown on the sloping hillsides only when it is necessary to plow and re-establish the sod.

Corn follows the sod crop in the rotation (figure 16) for several reasons. First, among field crops it best capitalizes on the soil organic matter and improved soil tilth left by the sod. Second, erosion is less likely than where corn follows a small grain or row crop. Third, it offers an opportunity to kill certain weeds that persist in meadows. Fourth, a forage seeding made in a spring grain that follows corn (or some other row crop) is usually better than when it follows sod because the seedbed is more firm.

Figure 14. Right, where corn is grown on the same field for many years, high yields can be maintained by adequate fertilization, use of cover crops and good soil management.

Figure 15. Above, on a combination hill-valley farm, corn should be grown on the sloping hillsides only when it is necessary to re-establish the sod.

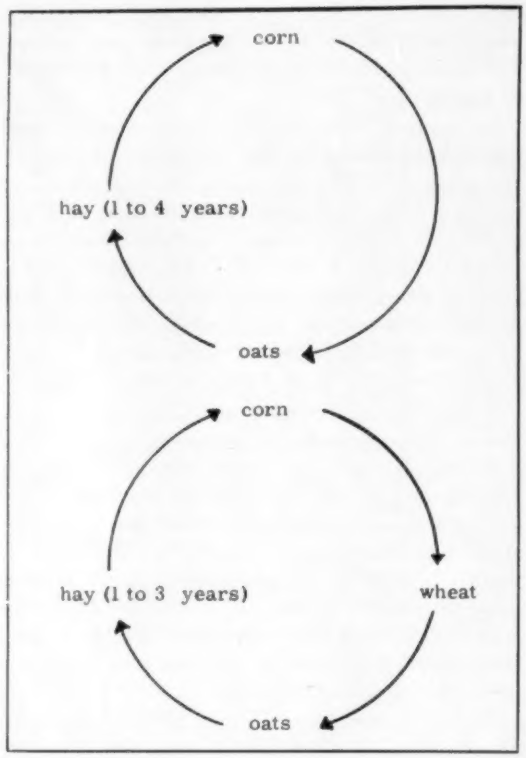


Figure 16. Right, corn follows the sod crop in the rotation as it best capitalizes on the soil organic matter and improved tilth left by the sod.

CHOOSING THE RIGHT HYBRID

Since most hybrids offered for sale have a high yield potential, perhaps the most important factor for a farmer to consider is the maturity rating. The second most important point is resistance to stalk rot and standability for grain corn. Each year the Plant Breeding Department at Cornell University makes available the ranking of important hybrids in maturity, yield, and standability to farmers, county extension workers, local seed and fertilizer dealers, and others. This annual listing is the best source of up-to-date information on the available hybrids.

Choosing the hybrid of the proper maturity rating needs special attention. Its full significance is not yet well understood by most farmers and by many who advise farmers. The typical growth curve for the corn plant is shown in figure 17.

The corn plant starts slowly and then grows very rapidly for a few weeks before and after silking. The plant takes 55 to 60 percent of the total period

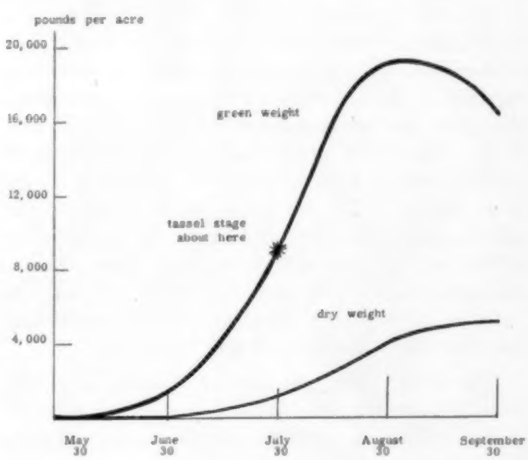


Figure 17. The development of green weight and dry weight in the corn plant through the growing season. (Cornell Memoir 152, 1934, Early Huron Variety).

from planting to maturity to reach the silking stage and 40 to 45 percent of the days to develop the ear. The plant builds about half of the total dry weight by silking time.

An understanding of the contribution of each part of the plant to the total dry weight (figures 18 and 19) is helpful in comparing whole plant silage, ear corn silage, and grain. It is also the basis for deciding the proper stage to cut for silage. Most people overestimate the stalk and leaves and underestimate the ear and grain. When the plant is fully mature, the *ear (grain, cob, husks) makes up nearly ⅔ of the entire above-ground dry weight!* Grain alone accounts for ½ of the dry weight of the plant.

Toward the end of the growing period the moisture in the ear is the key to the nearness to maturity. The relation of moisture in the grain to the appearance of the kernels and to the development of the kernel is shown in figure 20. Note that when the grain contains 60 percent moisture the grain is slightly more than half developed. At 50 percent moisture the grain is nearly ¾ developed. The grain is fully developed when the grain averages 35 percent moisture. Growth is complete and from this point the ear simply dries out.

Figure 22 shows the relation between the moisture in the grain and in the whole ear. The cob develops first and thus for a short time the grain contains more moisture than the ear as a whole. The moisture in grain and cob are about equal at 66 percent moisture. From that point on, the grain is drier than the cob. This continues until the grain approaches 15 percent which is seldom reached under field conditions in New York. The difference in moisture between grain and cob is of importance to the person who is considering artificial drying of ear corn or shelled corn. At 30 percent moisture in the grain, the cob contains 30 percent of the water to be removed in order to bring the grain to 15 percent, which is a common goal in drying. If the field moisture in the grain is 35 percent, the cob contains about 33 percent of the water to be dried out. It is obvious from these figures that a saving in drying cost can be made by shelling the corn before drying. Harvesting, storing, and drying are discussed further on pages 26 to 28.

The field weight, number of bushels, or wagon loads of corn are poor bases for comparing hybrids, especially if there are differences in maturity. Figure 21 shows the number of pounds of ear corn at moistures from 15 to 45 percent required to equal a standard bushel. When corn first reaches maturity at 35 percent moisture in the grain it takes 93

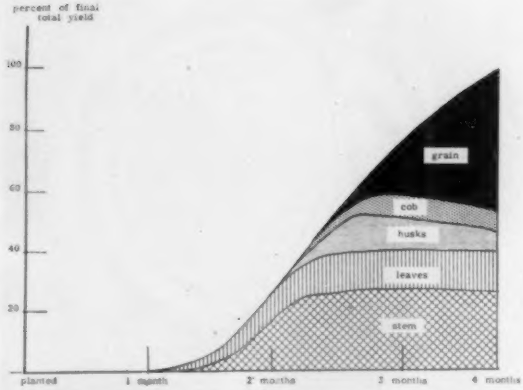


Figure 18. The accumulation of dry weight in the several parts of the corn plant through the growing season. (Prepared from data in Plant Physiology, Volume 23, page 270. Table 1).

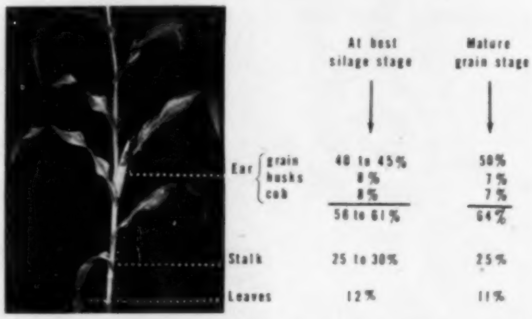


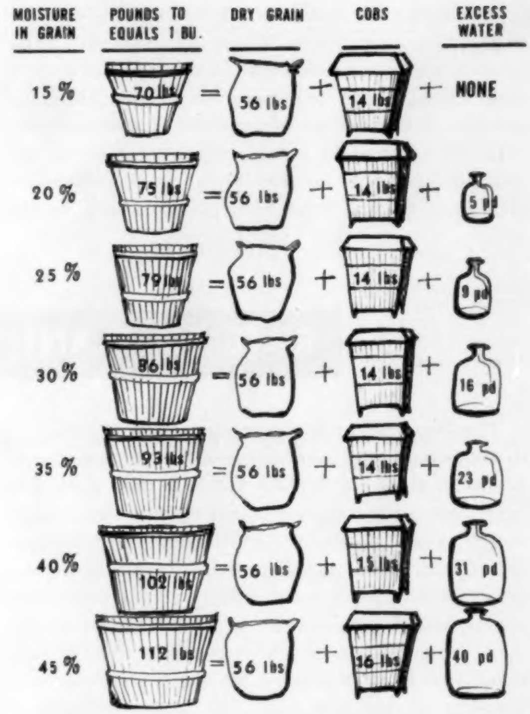
Figure 19. The approximate distribution of dry weight among different parts of the corn plant at the ideal silage stage of growth and when the grain is mature.

Figure 20. The development of corn grain at different moisture contents in the grain.

pounds to equal 70 pounds at 15 percent moisture. The *extra 23 pounds is all water.*

When the moisture content is above 35 percent, the cob is fully developed but the grain is not. This accounts for the figures of 15 and 16 pounds for cobs at 40 and 45 percent moisture. The standard figure for shelling percentages for mature corn is 80 although most modern hybrids average 81 to 83.

It is common practice to list corn as a 90-day, 100-day or 110-day hybrid. This should not be interpreted to mean that the corn will mature in the stated number of days. This varies from year to year, from one farm to another, and from the Corn Belt to the northeast in the same year. The designation is a measure of *relative* earliness or lateness. For a new hybrid the most useful information for a farmer to have is to know how it compares in earliness with a hybrid that he has grown before.



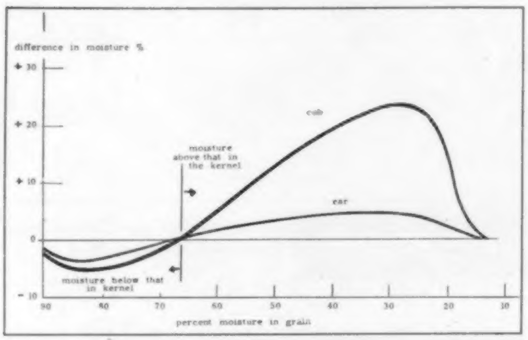


Figure 21. Above, the relationship of ear corn at different moisture contents to dry shelled grain and excess water.

Figure 22. Left, the curves show the relation between moisture in the grain and moisture in the cob and ear at different stages of ear development. Adapted from Purdue Experiment Station Bul. 599. 1953. Table 1.

DATE TO PLANT

Planting corn reasonably early has three advantages. First, it helps to assure well-earned corn for silage or fully mature, low-moisture corn for grain. Second, it permits growing a hybrid in a slightly later maturity grouping. More farmers, however, choose too late than too early hybrids. Third, it allows silage harvesting or corn picking earlier in the fall which sometimes avoids unfavorable fall weather.

There is no exact guide to the best time to plant. Figure 23 shows when corn planting starts in New York in a typical year. Within each zone there are differences of one to two weeks between the well-drained soils at low elevation and the poorer drained soils at higher elevations. The general farm

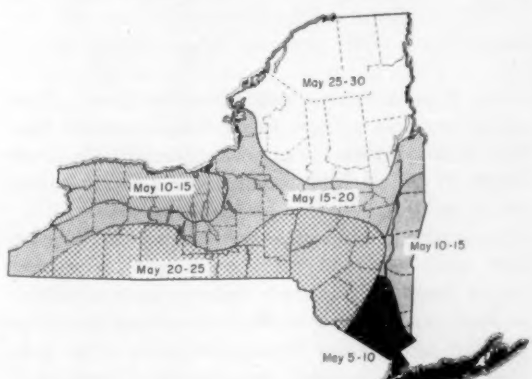


Figure 23. The map shows about where corn planting starts on the well-drained soils in a typical season. The zones are general and there is often a range of 10 to 15 days within a zone due to the differences in drainage or elevation.

experience in the community is a fair guide on date to plant for a newcomer. There are, however, many farmers who have not adjusted their planting date since effective seed treatment has become standard practice. Before the use of treated seed, early planted corn often rotted in a cold, wet soil. Observations indicate that the farmers with the highest corn yields are among those who plant earliest in the area.

The plow-plant method described on pages 17 to 20 may advance the date of planting by a few days to a week. The soil can be plowed when it would be too wet to harrow. The unpacked furrow slice should dry and warm more rapidly than when a full seedbed is prepared.

Two weeks difference in planting date makes about one week difference in maturity at the end of the season.

RATE TO PLANT, PLANT POPULATION

The Department of Agronomy at Cornell starting in 1946 conducted extensive trials on the number of plants to grow for highest yield. Earlier work had been done with open-pollinated varieties and before modern rates of fertilizer application became popular. Recent farm trials (figure 24) show that highest grain yields over a wide range of field conditions are obtained with 16,000 to 20,000 plants to the acre. Observations on farms indicate that farmers usually plant thick enough for silage, but that many plant grain corn too thin. The plants per acre in 466 fields in 1949 to 1953 are shown in table 9. Only

Table 9. Plants per acre in 466 New York fields of corn for grain, 1949-1953

Plants per acre	Number of fields	Percent of fields	Percent of maximum possible yield
Below 9,000	3	0.6	Less than 68
9,000 to 11,999	76	16.3	71
12,000 to 13,999	110	23.2	85
14,000 to 15,999	134	28.5	92
16,000 to 17,999	81	17.4	97
Above 19,000	62	13.3	100

about 30 percent have 16,000 plants or more. These are better than average fields. The stands in New York fields of corn for grain are likely below those shown in table 9. Many farmers could increase their yields by 10 to 20 percent by planting thicker.

In general, early hybrids which have small plants and small ears will tolerate closer spacing than larger, later hybrids. Late hybrids with large ears or those with a tendency to produce two ears when planted thin do not show as large decreases from thin stands. Research is in progress to identify or to develop hybrids that have the inherent ability to withstand crowding.

Many farmers ask whether thick stands suffer more from drouth. The answer is "yes", unusually high plant populations are more likely to be injured

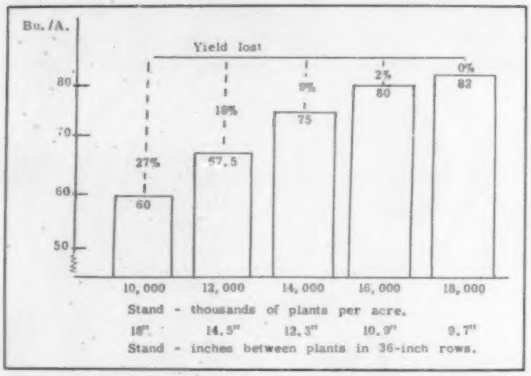


Figure 24. Influence of stand on yield of corn. From three years of over-state farm trials in New York.

by drouth. Trials for several years in New York show that the recommended stand of 16,000 to 18,000 plants will produce 95 to 98 percent of the maximum possible yield in the best growing seasons and will not be unduly affected by drouth. Stands of 20,000 or more definitely yield less than thinner stands in dry years and should be considered only by farmers with excellent soil conditions including good moisture supplying power.

Many trials in New York suggest that the plant population should not be reduced below 16,000 per acre even for soils with only a moderate productivity level unless, perhaps, the soil is very drouthy.

Lodging is less in fields that have 16,000 to 18,000 plants than in those with higher populations.

Most persons think of the stand of corn in terms of the distance between plants within the row. Difference in row width must also be considered. The number of plants per acre takes into account row width and spacing within the row. Table 10 shows the number of plants per acre at different row

widths and spacing between plants in the row. Table 11 shows an easy method for making a rough field check on plants per acre. This may be done at any time during the growing season or after the corn is harvested.

About 70 to 80 percent of the germinable corn kernels produce fully developed plants. In order to obtain the plant populations in table 10 it is necessary to plant 20 to 30 percent more kernels. For plant spacings of 10 inches or less, kernels may be dropped on the average 1 inch closer together than the desired distance between plants. For plant spacings of 10 to 15 inches, kernels should be 2 inches closer than the expected plants. After the corn planter is set according to the manufacturers instructions, a trial run should be made on a hard surface *at the same tractor speed that will be used in the field.*

The stand of corn is usually best when the tractor is driven at 3 to 4 miles per hour. Higher speeds often give thinner stands. Some reasons are that the planter may not discharge the expected number of kernels, kernels may be broken and fail to germinate, or the fertilizer in the case of a split-boot type of planter may be too close to the seed and cause "fertilizer burn".

Table 10. Plants per acre at different row widths and distances between plants in the row

Distance between plants	Row width: 32 inches	34 inches	36 inches	38 inches	40 inches	42 inches
Inches			*Plants per acre*			
6	—	—	29,040	27,540	26,130	24,890
7	28,000	26,340	24,890	23,630	22,410	21,330
8	24,500	23,060	21,780	20,640	19,600	18,670
9	21,780	20,500	19,360	18,340	17,424	16,590
10	19,600	18,450	17,420	16,510	15,680	14,930
12	16,330	15,360	14,520	13,750	13,070	12,450
14	14,000	13,180	12,450	11,790	11,200	10,670
16	12,250	11,530	10,890	10,317	9,800	9,330
18	10,890	10,250	9,680	9,170	8,710	8,300
20	9,800	9,220	8,710	8,250	7,840	7,470

Table 11. Number of plants in 50 feet of row of different widths to equal plant populations of 12,000 to 18,000 plants per acre

Row width in inches	Plants per acre: 18,000	16,000	14,000	12,000
		Plants in 50 feet of row		
32	56	50	44	37
34	59	52	46	39
36	62	55	48	41
38	65	58	51	43
40	68	60	53	45
42	71	63	55	47

PREPARING THE SEED BED

TIME TO PLOW. Most fields are plowed in the spring for corn. This keeps erosion to a minimum on sloping fields. A green manure crop, cover crop, or hay meadow has additional time to grow in the fall to add organic matter and also nitrogen if it is a legume.

Whether to plow early in the spring or shortly before planting time depends upon how soon the soil dries enough to plow, the competition for labor and equipment for other work that is more urgent, and in a dry spring the kind of cover in the field. If April is unusually dry, it may be advisable to plow a vigorous sod early to prevent it from depleting the available moisture to the rooting depth.

The significance of the amount of spring topgrowth on legumes from a soil improvement standpoint is commonly misunderstood. From research in other states it is clear that the total amount of nitrogen and organic matter in tops and roots of alfalfa changes very little from early spring until about May 15 in New York. The early spring growth is primarily a transfer of stored materials from the roots. During the first month of spring growth, the root dry matter weight decreases almost as fast as topgrowth dry matter increases. Red clover likely increases in total organic matter slightly earlier, but the fact remains that unnecessary delay in plowing a legume in order to get more soil improving benefit is far less important than it appears to be when estimated from topgrowth.

If a minimum tillage method, described on pages 17 to 20, is to be used, then plowing may necessarily be delayed until near planting time.

Fall plowing is common on the level heavy clay soils in Niagara and Orleans counties and adjacent areas and on the clay soils in northern New York. If these soils are plowed when slightly too wet, they dry into hard clods. When fall plowed, the clods slake down over winter and are often much easier to work into a desirable seedbed than when spring plowed.These soils are frequently wet into late spring. Planting is delayed more with spring

plowing because the entire plow layer must be dry enough to work before plowing can start. Fall-plowed fields may be fitted and planted as soon as the surface 3 to 4 inches is dry. Working the soil at this time results in compaction of the lower part of the plow layer and upper subsoil under the weight of the tractor wheels but this may be preferable to delayed planting.

Fall plowing should be confined to fields that are nearly level and where erosion is unlikely. If sloping fields must be fall plowed, plowing should be across the slope or on the contour and the surface should be left rough rather than disked or cultipacked.

Many New York farmers could simplify their harrowing operations and early control of grass by better plow adjustment and with special devices on the plow to turn under trash and sod (figure 25).

DEPTH TO PLOW. The New York Experiment Station has not compared different depths of plowing. This has, however, been studied by many states during the past 40 years and the results are surprisingly consistent. Yields increase economically with deeper plowing to about 8 inches. Beyond that, the extra yield rarely pays for the extra power to pull the plow. There is no evidence to indicate that the current interest of a few farmers in plowing 10 to 11 inches deep is justified. The real topsoil in New York is seldom more than 8 inches deep. Plowing up subsoil that is low in organic matter and sometimes difficult to manage is not likely to pay in the short run. The possibility remains that there may be desirable cumulative long-term effect from deep plowing to make a deeper "topsoil". Research is in progress at Pennsylvania State University to study methods for deepening the "topsoil" and the results will be useful in New York.

SUBSTITUTES FOR PLOWING. It is hard to beat the moldboard plow in humid regions. It works well on both sands and clays and with every cover from tough sod to cornstalks. No tool is more efficient in the use of power for the work done. No tool results in fewer weeds.

The Ohio Agricultural Experiment Station has a long-term experiment under soil and climatic conditions which likely indicate the results that would be obtained in New York. The results are shown in table 12. No tool excelled the moldboard plow for the first step in seedbed preparation. Limited trials in New York show results similar to those in Ohio for rotary tillage and disking. Other research in New York suggests that stirring poorly drained soils to plow depth several times in the rotation favors high yields.

Table 12. Corn yields following different methods of seedbed preparation

Treatment	Yield 14-year average
	Bushels of grain
1. Standard plow plus disking	53.4
2. Long moldboard plow plus 1 light harrowing	54.5
3. Rotary tillage 2 or 3 times	46.9
4. Subsurface and surface sweeps	44.7
5. Surface sweeps only to kill sod	40.2
6. Same as (1) plus a straw mulch	54.9

Research in areas with normally plentiful rain in the northern half of the United States shows that trash left on the surface reduces corn yields. A partial explanation may be that trash keeps the surface more moist and cool during the early part of the season when young corn seedlings are favored by higher temperatures than usually prevail.

On fields where there is no trash to turn under, it is likely that any substitute for plowing that stirs the soil about 8 inches deep will be satisfactory.

FITTING OPERATIONS AFTER PLOWING. Many farmers can reduce their costs by working the seedbed less after plowing, providing the rootstocks of perennial weeds are not a serious problem. Table 13 shows the results of harrowing one, three, and nine times after plowing. The five-year average yields are about equal. The extra harrowing cost money and gave no return.

Table 13. Yield of corn when plowed ground was harrowed 1, 3, and 9 times
Marcellus Research Farm, Onondaga County, 1952-1956*

Number times harrowed	Yield, 5-year average
	Bushels
1	83.8
3	82.8
9	82.6

*Annual Research Report, Eastern Soil and Water Management Section, Soil and Water Conservation Research Branch, A.R.S.

There is no simple guide on how to handle a field after it is plowed. A good goal may be to plow carefully, then fit enough to level the surface, fill in the large breaks, and provide a seedbed where the kernels can be planted near a uniform depth and with just enough fine soils to give good seed-soil contact. Extra fitting usually results in more rather than less weeds because the surface is made more favorable for the germination of small weed seeds.

On most farms the seedbed prepared for corn has changed little in the past 50 years. It is likely to be

more thoroughly prepared now because of the additional power available. Research started in Ohio in 1938 (table 12) revealed that corn would grow well when planted directly in freshly-plowed ground, provided the zone near the seed was leveled, firmed, and refined.

MINIMUM TILLAGE METHODS

Since 1950, several promising new methods for preparing corn seedbeds have been tried.

They are (1) wheel-track planting, (2) planting on plowed ground with a leveling-packing tool attached behind the plow, (3) plow-planting, and (4) mulch-tiller planting.

They require much less work and seem to offer other advantages over conventional methods.

"Minimum tillage"—as the new methods are called—has five aims:

1. To save labor by reducing the number of trips over the field.
2. To reduce soil packing from heavy wheel tractors.
3. To increase the rate at which water enters the soil by leaving the surface loose and open.
4. To reduce soil erosion by reducing water runoff and by leaving the soil in small aggregates or granules which are less easily carried off the field by water or wind.
5. To reduce weeds by leaving the soil surface too loose for annuals to germinate.

It is important at the outset to present a concept of the seedbed that is obtained for the corn. Contrary to popular belief, the *corn is not planted in freshly plowed ground without additional seedbed preparation.* Note in figure 25 the extent to which the breaks in the furrow slice are filled, the row surface is leveled, and the row area compressed. The goal in any minimum tillage, and especially plow-plant, is to prepare an adequate seedbed within the row, but to leave the area *between rows* somewhat rough.

A good seedbed around the corn kernel is absolutely essential. In order to germinate, the corn kernel must obtain moisture from the soil. In a soil with the proper moisture content for plowing, working, and planting, moisture moves into the kernel from close contact with the soil. A kernel will not take up enough water for germination from a cloddy seedbed. If the row area is coarse and open, the surface of the clods and large aggregates soon dries out and there is little moisture available to either the seed or young roots. If rain comes soon after planting and the soil remains well supplied with moisture for at least a month after planting, a relatively fine, firm seedbed within the rows is less important.

PLOW-PLANT. This method combines plowing and planting into a single operation. R. B. Musgrave, agronomist at Cornell, developed the technique through several stages. He began in 1951 by trailing a 2-row planter behind the plow (figure 26).

Figure 25. Better plow adjustment and the use of jointer or other device to do a better job of burying sod and trash would simplify harrowing operation.

Figure 26. In early plow-plant trials (1951), a 2-row planter trailed behind a 3-bottom plow.

In 1954 he mounted planter units on the plow (figures 27 and 28). In 1956 he tried a third method (figure 29) in which the planter unit was mounted on the tractor.

A 3-bottom, 14-inch plow plants one row at a time, 40 to 42 inches between rows. A 5-bottom, 14-inch plow can plant two rows 35 inches apart. A depth gauge (figure 30) has been used to firm the row area and control planting depth. Row width is surprisingly uniform in level to moderately sloping fields that are free from large stones which would cause the plow to jump sideways. Even when planted one row at a time, the fields may be cultivated with a 2-row and oftentimes 4-row cultivator. Rows seldom vary more than 2 or 3 inches in width.

In addition to experiment station trials initiated in 1951, the system has been widely tested on New York farms since 1955. The yields obtained on farm trials in 1956 are shown in table 14. The two conditions under which plow-plant has been unsatisfactory are when extended dry weather precedes and follows planting, and when the ground is so wet or cloddy that an acceptable seedbed cannot be prepared in the row.

Plowing must be done at a time when the furrow slice is mellow enough to yield sufficient fine material around the seed. Silt loams, loams, and sandy loams are more easily plow-planted than clay loams and clays because they are less likely to be sticky and cloddy (figures 31 and 32). The finer-textured (heavier) soils may be plow-planted if they have good tilth and are plowed at just the right time (figure 25). Modifications for the preparation of the row area described later will likely extend plow-plant to soil situations not now considered suited to it.

Figure 27. In a later modification the planter unit was mounted on the plow.

Table 14. Summary of farm trials with the plow-plant method compared with conventional seedbed preparation, New York, 1956. Unpublished data from E. C. Dunkle

Farm cooperator and county	Crop in 1955	Soil Series	Yield: Silage, Plow-plant	Yield: Silage, Conventional	Yield: Grain, Plow-plant	Yield: Grain, Conventional	Plants per acre: Plow-plant	Plants per acre: Conventional
			T.	T.	Bu.	Bu.		
Stanley Stout, Yates	Corn	Ovid silt loam	5.44	6.04	77.5	88.3	15,000	18,360
William Welles, Chemung	Alfalfa sod	Chenango loam	4.74	4.21	72.4	67.1	16,100	15,600
Gannett Farms, Monroe	Wheat	Ontario silt loam	4.09	4.50	78.5	87.5	14,600	15,300
Howard Hill, Orleans	Wheat	Ontario silt loam	3.77	2.96	73.0	59.0	15,800	12,700
Herb Kroening, Niagara	Timothy sod	Hilton loam	3.02	2.98	58.8	53.7	14,700	14,900
Tom Youngs, Schoharie	Timothy	Farmington loam			53.4	41.3	18,400	16,700
Stanley Benham, Dutchess	Alfalfa	Albia-Troy loam	3.38	3.70	65.2	67.9	12,700	11,650
Paul Mosher, Oneida	Bluegrass	Ovid silt loam	5.50	4.63			13,600	13,200
Glenn Porter, Jefferson	Bromegrass	Kars loam	3.45	3.58			15,300	14,650
Stafford & Sons, Clinton	Bromegrass	Amenia fine sandy loam	3.99	4.01			18,850	18,900
Asher Goodale, Cortland	Alfalfa sod	Valois silt loam	3.65	2.69				
Ed Sharp, Genesee	Corn	Lima-Kendaia silt loam	3.77	2.94				
Average			4.07	3.84	68.4	66.4	15,500	15,200

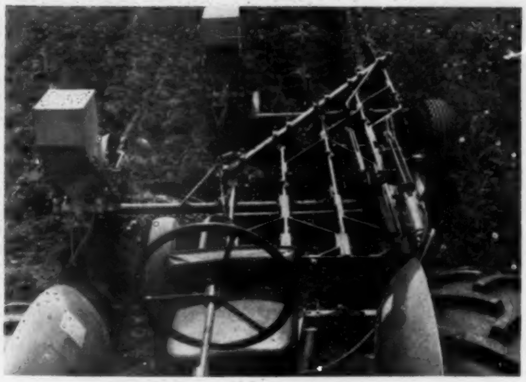


Figure 28. Two-planter units mounted on 5-bottom plow. A 5-bottom, 14-inch plow can plant two rows 35 inches apart.

Figure 29. Planter unit mounted on tractor rather than on plow was used in 1956 trials.

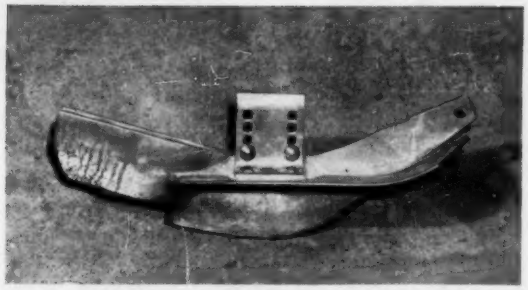


Figure 30. Depth gauge used to firm the row area and control planting depth.

Figure 31. Plowing must be done when furrow slice is mellow enough to yield fine material to cover seed. Silt loams, loams, and sandy loams are best.

Figure 32. Clay loams and clay soils can be a real problem as they are likely to be sticky and cloddy. Plowing must be done just at the right time.

The follow-up treatment after the corn emerges is somewhat different from the usual practice. The corn grows in a furrow often with sizable clods next to it which would be rolled onto the row with a shovel cultivator. This is only a minor problem if weeds are not present and cultivation can be postponed until the corn is 12 to 18 inches tall. When earlier cultivation is necessary, a cultipacker (figure 33) or rotary hoe works well to break the clods and smooth the surface. The field can then be cultivated as usual.

Generally there are fewer weeds in plow-plant than in any other method of seedbed preparation. The loose, somewhat cloddy surface of the furrow slice between the rows is an extremely unfavorable situation for annual weeds to germinate and grow except in a very wet period.

Further improvements in the design of plow-plant equipment is expected mainly along the line of more fitting and compression within the row, perhaps with pneumatic tires ahead and behind the planter shoes.

WHEEL-TRACK PLANTING. Wheel-track planting was started by R. L. Cook at Michigan State University in 1946. The field is usually plowed just ahead of planting so that the furrow slice doesn't have time to dry out and get hard, and rain cannot intervene between plowing and planting. A small tractor is needed if the wheels are to be adjusted to the usual corn row width. A 2-row planter places the corn row directly in the tractor wheel tracks. The soil is firm around the seed. The corn germinates and comes up quickly.

PLOW WITH PACKER-LEVELER ATTACHED. Minimum tillage can be adapted to 2- or 4-row planting by attaching a packing, leveling tool to the plow (figure 34) and then planting without further seedbed preparation. Limited observations on the method indicate that good soil tilth and favorable soil moisture following planting are essential to success.

At least one farm machinery manufacturer has introduced a corn planter with small rubber-tired wheels ahead of each planter shoe. This should materially increase the likelihood of obtaining a good stand of corn. Such a planter would seem to offer possibilities for planting on fall-plowed fields with little or no spring tillage. Weeds could be controlled by spraying in early spring, spraying at planting time, or by mounting sweeps on the planter ahead of the planter shoes.

TILL PLANTING. The International Harvester Till-Planter prepares a seedbed and plants two rows in one trip. The corn row is prepared with a narrow, deep-running sweep, a wider sweep that runs shallow, and rotary hoe sections. The strip between rows is left unstirred. In sod, this strip can be cultivated out later. Till-planting on the contour is an excellent soil conservation measure.

In experiments with sod between rows, till-planting gave reduced corn yields. The greatest reduction, of course, was in dry years. Extra fertilizer is applied to make up for the nutrients not released from the unplowed sod strip between the rows. This doesn't apply when till-planted corn follows corn or soybeans.

Till planting has several disadvantages. It is only a 2-row operation; the entire operation is delayed until corn planting time; the plant growth between rows competes for moisture in a dry season; extra fertilizer is needed following sod; a special machine and considerable power are required.

Figure 33. A combination cultipacker-weeder used on plow-plant corn. This breaks up clods and smooths the surface.

Figure 34. A packer-leveler tool will break and level surface of furrow slice and allow planting without further seedbed preparation.

FERTILIZING

Compared with some other field crops, corn has a short growing season, produces a high yield, and has a high acre value. These factors favor heavy fertilization. On the other hand, corn grows during the warm summer months when the release of plant nutrients from the soil humus and fresh plant residues is most rapid. Corn often gets sizable amounts of nutrients from these sources.

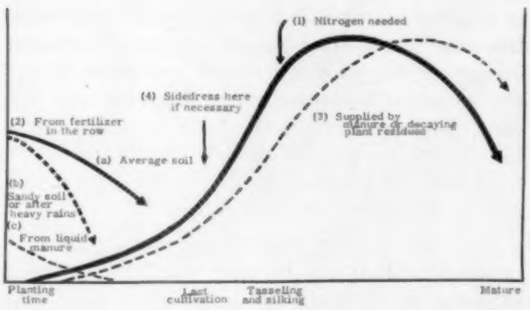


Figure 35. The fertility needs of the corn crop through the growing season. The nitrogen need increases sharply from about the last cultivation to tasseling stage.

Figure 35 shows in a general way the fertility needs of the corn crop through the growing season. The curve is primarily for nitrogen, but also has significance for phosphorus, potassium, and water. The nitrogen need (1) is low when the plants are small. The curve rises sharply from the knee-high to the tasseling stage.

The row fertilizer (2) is near the plant roots and helps to get the young plants off to a quick start. The nitrogen from the row application is gradually used up or leaches out (arrows (a) and (b)). The rates and amounts of leaching depends upon the soil texture and amount of rain. Leaching is greatest in sandy soils, least in clays.

The nitrogen that is available from humus, plant residues, and manure is indicated by the dotted line (3). Manure also contains some nitrogen in the liquid portion that is immediately available, (c). The curve showing nitrogen from manure, residues, and humus tends to parallel the curve showing nitrogen needed. This shows why these sources are so highly desirable for corn.

KINDS OF FERTILIZER FOR CORN. Extensive research shows that equal amounts of nitrogen (N), phosphoric acid (P_2O_5), and potash (K_2O) are desirable for corn following a legume sod or where manure is applied. If neither a legume nor manure is available then the amount of nitrogen should be nearly doubled. A 1–1–1 ratio fertilizer such as 10–10–10, 12–12–12, or 13–13–13 is a good choice for the row application. A 1–2–2 ratio may be used in the planter with the extra nitrogen being plowed under or sidedressed later.

When large amounts of low nitrogen materials such as corn stalks, straw, or mature grass are plowed under, the soil microorganisms often compete with the corn plants for available nitrates and the corn suffers. There are two solutions to this problem. One is to supply the corn plant with adequate fertilizer nitrogen to meet its needs while the residues are decaying. This is the preferred method. The second method is to apply extra nitrogen in contact with the residues and plow it under. This nitrogen will be used by the microorganisms and transformed into humus. It is likely that this nitrogen will be used less efficiently than the nitrogen fertilizer applied for the corn either at planting time or as a sidedressing.

The leaching of nitrogen that is plowed under can be reduced by delaying the application and plowing until shortly before planting.

In general the many different forms of nitrogen may be compared on the basis of the *cost per pound of nitrogen plus the cost of application.* Here is a brief description of the common sources of nitrogen for direct application.

Ammonium nitrate: NH_4NO_3, 33.5% nitrogen in dry pellet form. One-half of the nitrogen is in the nitrate form and one-half in the ammonium form. Usually medium to low priced per pound of applied nitrogen. Suitable for plow under or sidedressing.

Ammonium sulfate: $(NH_4)_2\,SO_4$, 20.5% nitrogen in dry crystal form. All nitrogen in ammonium form. Usually above average in cost of nitrogen. Suitable for plow under or sidedressing.

Anhydrous ammonia: NH_3, 82% nitrogen in gas form with 211 pounds of pressure per square inch at 104° F. Lowest cost per pound of nitrogen but the cost of application with high pressure equipment increases the cost somewhat. Up to 1957 there were only a few suppliers in New York. Well suited to

pre-plant application or sidedressing. Must be inserted at least 4 to 5 inches under the surface to prevent the loss of nitrogen in gas form. Root pruning can be severe unless done when plants are small. If sidedressed, applicator knives should be kept 12 to 14 inches away from the row.

"Cyanamid": $CaCN_2$, 20.5% nitrogen in dry pellets. The nitrogen changes to the ammonium form in the soil. Usually medium in price. When used on soils that require lime, the actual cost of the nitrogen may be reduced by 2 cents per pound because of the neutralizing value of the calcium. Best suited to plow under.

Nitrate of soda: $NaNO_3$, 16% nitrogen in dry form. All nitrogen in the nitrate form. This means that it is immediately available but readily leached with excess rainfall. The highest priced source of nitrogen. Suited to sidedressing but other sources are preferred for plow under.

Urea: $CO(NH_2)_2$, 40 to 46% nitrogen in dry pellet form. Considered to be an ammonium source of nitrogen. When urea was first used extensively in the early 1950's it was one of the highest priced sources of nitrogen, but with increased use, it has become medium in price. It is highly soluble and is used in liquid sprays. Suited for plow under or sidedressing.

Nitrogen solutions: The most common ones contain 32% and 41% nitrogen. The 32% solution is a combination of ammonium nitrate and urea. It is the nitrogen fertilizer best suited to foliar application since it is least likely to burn.

The 41% solution is ammonia in ammonium nitrate and is often diluted with a small amount of water to reduce the vapor pressure and prevent loss by volatilization. It should be released at least an inch under the soil surface or allowed to trickle on the furrow slice as it is turned under. Special equipment with aluminum or stainless steel fittings is needed since this solution corrodes bronze or brass. Suited to plow under or sidedressing. This is one of the lowest cost sources of nitrogen but does require special equipment to apply.

Liquid complete fertilizers are a new development in fertilizers which started in the Corn Belt about 1954. By 1956 they were competitively priced with dry fertilizers. The greatest advantage is that handling is done by pumps and gravity. In terms of crop response, liquid and dry forms of fertilizers are expected to be about equal. The main disadvantage from the farmer's point of view is the special equipment needed for storing and distributing. Custom spraying is common in the Corn Belt but this method of application results in much less efficient use of the fertilizer in New York.

Foliar applications of nitrogen, phosphorus, and potassium fertilizers are not practical for field corn. The amount of nutrients that can be applied at one time without burning is so small that 5 to 10 sprayings would be needed to apply the amounts usually put on as dry fertilizer at planting time. Foliar sprays of minor elements are, however, economical for other crops under certain conditions.

RATE TO FERTILIZE. Fertilizer recommendations are constantly changing because of new research data and changes in the price of fertilizer and value of a bushel of corn. The expected response to a given amount of fertilizer remains the same from one year to the next. If the price of corn goes up and/or the price of fertilizer goes down, it will pay to apply somewhat more fertilizer and vice versa. Farmers may get the latest fertilizer recommendations from their county agricultural agent, local seed and fertilizer dealer, the New York State College of Agriculture, and others.

Fertilizer recommendations are usually given in rather general terms. Farmers who have complete information about their soils, including a soil test, plus understanding about the fertility requirements of the corn plant can improve upon the general recommendations and thus make them fit their own special situation somewhat better. Differences of opinion among so-called experts on the best fertility program for corn are due to the fact that fertilizing field crops is still not highly precise. Sound judgment on the part of the farmer is essential.

Sound supporting practices are absolutely necessary in order to "cash in" on the potential yield increase from fertilizer. Planting and cultivating must be done on time. A good stand is needed; 10,000 to 12,000 plants to the acre will not give full response to heavy fertilization. Weeds must be controlled. A good hybrid is required. The fertilizer must be placed properly. Neglecting any of these factors may mean that extra money put into fertilizer is wasted. *Current fertilizer recommendations are based on the assumption that all good practices are followed.* Where the soil and climate are unusually well suited to corn, it will *sometimes* pay to apply 25 to 50 percent more fertilizer, especially nitrogen, than is shown in tables of recommendations.

What about fertilizing corn according to the amounts of plant nutrients that are contained in the crop? The approximate amounts of certain

nutrients removed by a 100-bushel corn crop are shown in table 15. If a crop were being grown in

Table 15. Approximate amounts of certain fertilizer nutrients contained in the grain, stover, and roots of a 100-bushel corn crop. Information from Purdue University

Nutrient	Pounds per 100-bushel crop of corn	
	Entire plant	In the grain
Nitrogen	130	86
Phosphorus	22	15
P_2O_5	50	35
Potassium	110	18
K_2O	132	22
Calcium	37	6
Magnesium	33	6
Sulfur	22	7

pure sand, the amount of nutrients contained in a good crop might bear a close relation to the amount to apply. Under practical field conditions it is a coincidence if the amount of fertilizer that it pays to apply approximates the amount shown in table 15. The soil is more than a storehouse for water and a medium to hold the plants up. The farmer's problem is not how to replace all nutrients removed but rather how to supplement those supplied by the soil in the most profitable manner. To answer this question, there is no substitute for field experiments and farm trials. Basic information about the kind of soil, the preceding crops, previous fertilizer applications, and careful soil tests can help a farmer to make adjustments in the general extension recommendations that will improve them for a particular field.

It is difficult to find any basis for urging farmers to apply more fertilizer for corn than is profitable in the long term view. When farmers apply all of the fertilizer that pays, the soil will seldom deteriorate in productivity.

A few farmers are anxious to obtain extremely high yields as a matter of pride or to win a corn growing contest even though the last few bushels in increased yield cost more than they are worth. These farmers will want to increase fertilizer 50 to 100 percent above college recommendations. The extra fertilizer may best be plowed under. Extra nitrogen may be plowed under or sidedressed. If the early part of the growing season has heavy, leaching rains, extra nitrogen should be sidedressed even though a large amount was plowed under.

In the maximum yield experiment of the Cornell Agronomy Department on the Aurora Research Farm the average yield in the first three years when current fertilizer recommendations were followed was 100 bushels of dry shelled grain per acre. When four times as much fertilizer was applied the yield was still 100 bushels.

Farmers could improve their information about fertilizer response by using one-half the regular amount of fertilizer on a few rows in each field and double the amount on another set of rows. Picking and weighing equal areas would be desirable, but even a rough estimate of the volume of ears in the wagon would be of some value.

FERTILIZER PLACEMENT. Fertilizer may be plowed under, applied near the row at planting time, or sidedressed. The row application deserves first priority. The best placement is 1½ to 2 inches to the side and 1 to 2 inches below the kernels (figure 36). This placement is safe because fertilizer does not move sideways enough to cause fertilizer "burn" to the seed. It is efficient because the young primary roots reach the fertilizer zone within a few days after the seed sprouts. On average soils, silt loam or heavier, up to 40 pounds each of N, P_2O_5, and K_2O (400 pounds of 10–10–10 or equivalent) may be safely applied.

Many corn planters have a split-boot fertilizer attachment. This places the fertilizer slightly to the side and slightly *above* the kernels. When operated at too high speed or when the boot becomes worn, the fertilizer may be placed almost in contact with the seed. Under most conditions at least 200 to 300 pounds of 10–10–10 or equivalent would be safe and frequently more is applied without injury. Place-

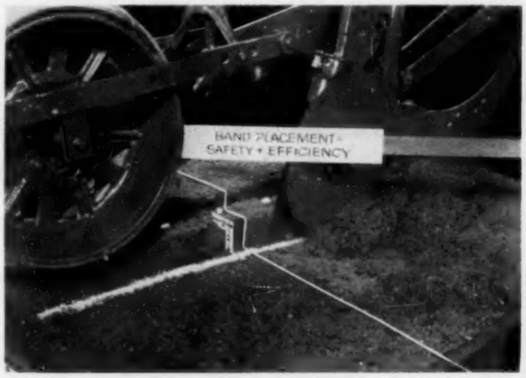


Figure 36. Placing the fertilizer to the side and below the seed is safe. The young roots of the corn plant reach this zone within a few days.

ment with the split boot is less efficient in giving an early start to the young corn plant than the placement described in the preceding paragraph because the fertilizer is *above* the first roots. The fertilizer zone is not reached by roots until the second root system develops later and slightly above the first roots. Nitrogen may, of course, be leached down to the first root zone, but phosphorus, which is urgently needed by young seedlings, does not move down to the roots. Corn planters with split-boot attachments should gradually be replaced or re-equipped on farms where fertilizer rates above 200 to 300 pounds to the acre are to be applied.

Up to the safe limit for the type of equipment used, the fertilizer may be applied near the row at planting time. First choice for additional amounts of mixed fertilizer is broadcast and plowed under or applied in bands on the plow sole if equipment is available. This is a very desirable placement in periods of moderate drouth because the corn roots continue to feed at plow depth but may absorb little fertilizer from that placed near the surface. Any broadcast method, however, results in less efficient use of water-soluble phosphates because they tend to be fixed when they contact acid soils. Broadcasting mixed fertilizer and working it into the seedbed is inefficient for field corn. Furthermore, it tends to favor weed growth between the rows.

Extra nitrogen beyond the row application may be plowed under or sidedressed at the time of the last cultivation. Broadcasting and plowing under places the nitrogen in contact with the residues and this may be undesirable, page 23. Furthermore, the nitrogen is applied early and there is a period of 6 to 10 weeks from application to the time the plant needs the nitrogen most urgently. Leaching may occur. The advantages of plowing under nitrogen are that it gets the work done at a time that is often less busy than later and it requires no special equipment.

Sidedressing requires equipment that many farmers do not own. It has two important advantages over plowing under. If anything happens to the corn crop in the early stages so that a high yield of corn is not possible, then a farmer may choose not to apply the nitrogen. If it is already plowed under, nothing can be done to recover it, and under New York conditions it will likely leach out before the following year. The second advantage is that the nitrogen is applied shortly before it is needed and there is less time for leaching to occur.

The soil conditions under which nitrogen sidedressing is most likely to pay are:

a. Sandy loam soils where leaching is high.
b. Years in which heavy, leaching rains occur after planting.
c. Fields that have not received manure.
d. Fields that are low in organic matter and have not had a sod crop in the preceding year.
e. Where the nitrogen application before planting or at planting time was too low.

Where manure is applied or a sod precedes corn on a medium to fine-textured soil that is moderately well supplied with organic matter, the entire amount of nitrogen can usually be applied before or at planting. The reasons for sidedressing in this situation might be to reduce the nitrogen in the row fertilizer to reduce the danger of "burn" or to use a lower cost source of nitrogen if available for sidedressing.

The kind of nitrogen for sidedressing may be selected on the basis of the lowest cost per pound of nitrogen except that calcium cyanamide is less desirable. Until it has undergone chemical change in the soil it is quite toxic to plant tissues.

Sidedress nitrogen should be placed no closer than 6 inches to the row and shallow enough that few corn roots are cut off.

CONTROLLING WEEDS

Weeds are an especially serious problem in corn in New York for several reasons.

1. Certain perennial weeds such as quackgrass thrive in long-term hay meadows and present a threat to row crops that follow.
2. There is much waste land adjacent to cropland and seeds blow across the fence.
3. Many soils are somewhat wet and timely cultivation is difficult.
4. Hay harvesting often competes with timely cultivation.
5. On many farms the acreage of corn is relatively small, and as a result, farmers do not give proper attention to the type of cultivator equipment or its adjustment.

There are three general types of weeds in corn: *annuals, biennials,* and *perennials.* The annuals start from seeds each year and die at the end of the

growing season. Examples of annuals are pigweed, lamb's-quarters, ragweed, several grasses and mustard. Perennials live for more than two years. Such weeds as quackgrass, Canada thistle, sow thistle, milkweed, horse nettle, nutgrass, chicory and cinquefoil are perennials. There are a few weeds such as wild carrot that begin growth in one year and complete it and die in the following year. They are winter annuals or biennials.

Annual weeds are easiest to control in corn because they can be attacked with cultivation or chemicals when they are very small. Completely killing the plant above ground is usually enough. Adequate moisture in the surface inch of soil is required for a new crop of annuals to sprout. To kill perennials it is necessary to kill a succession of new growth that comes from crowns at the surface or rootstocks below the ground. Perennials retain the ability to send up new shoots after one set is cut off. The rootstocks 3 to 12 inches below the soil surfact continue to send up new shoots even though the surface 2 inches is dry.

The moldboard plow is the most effective tillage tool for burying annual weed seeds and setting back perennials.

As was mentioned on page 17, a fine, firm seedbed favors annual weeds and sometimes perennials. Minimum tillage methods reduce, and in dry periods may eliminate, annual weeds. Some farmers believe that working the seedbed regularly over a period of 3 or 4 weeks before planting helps to control annual weeds by encouraging several crops to sprout and be killed off. Cultivations should be shallow to minimize bringing weed seeds to the surface. Otherwise, this will have little effect on the number of annual weed seeds that sprout after the corn is planted.

Early plowing followed by thorough harrowing at intervals of 2 to 3 weeks weakens perennials and may delay them enough so that they do not become a serious problem before the corn is large enough to cultivate.

CHEMICAL WEED CONTROL. The right chemical applied at the right time can usually replace one early cultivation and sometimes all cultivation.

There are three distinct approaches to weed control in corn:

1. A fall or early spring application before plowing for certain tough perennials.
2. Pre-emergence spraying after planting but before the corn emerges.
3. Post-emergence spraying after the corn is up.

Only a few general principles about chemical weed control are given here. The chemicals available and details about time and rate to apply change from year to year. Specific recommendations must be obtained each year from the College of Agriculture, the local county agricultural agent, local seed and fertilizer dealer, or perhaps a custom spray operator.

The first of the modern sprays to be widely used on corn was 2,4–D, introduced to New York farmers in 1946. By 1957 about 1/3 of the acreage was sprayed annually. This chemical is a growth hormone rather than a contact killer spray. It is most effective on broad-leaved annuals, but when applied as a pre-emergence spray, it often kills young grass seedlings. One problem with pre-emergence treatment when first tried on corn was that the spray sometimes leached down to the corn kernels and killed the young seedlings. Later research showed that the ester formulation leached less than others. Pre-emergence treatment with 2,4–D is not recommended for sandy or coarse gravelly soils because of the leaching danger. New chemicals are rapidly being developed which are superior to 2,4–D for specific purposes.

Post-emergence spray with 2,4–D is applied at a much lower rate of chemical than pre-emergence. A guiding principle often overlooked is that the *smaller the weeds the easier they are to kill;* conversely, the *smaller the corn the more resistant it is to injury.*

After spraying with a growth regulator such as 2,4–D, the corn often becomes brittle for 10 to 14 days. Cultivation should be avoided if possible because the brittle plants break easily when bumped.

Cultivation destroys the effect of a pre-emergence treatment and should, therefore, be delayed as long as possible.

CULTIVATION FOR WEED CONTROL. Until more effective and longer lasting chemicals are found, the cultivator will remain an important part of weed control programs. New York farmers could learn much from Corn Belt farmers in cultivator

Figure 37. Proper cultivator adjustment and cultivating at the right time are an important part of effective weed control.

adjustment (figure 37) and the importance of cultivating at the right time. The rotary hoe and spike-tooth harrow are effective tools to kill small weeds but they are not suited to stony fields. For tough perennial weeds shovels will cut off the weeds whereas narrow springteeth allow them to slide by without being cut.

The root systems of corn plants grow rapidly and meet between the rows when the plants are about knee high. If the surface soil is moist there will be many roots in the top 3 or 4 inches. After corn is 10 to 12 inches tall the best technique is to use wide, shallow-running shovels to throw soil into the row area to bury weeds rather than to cultivate deep and close. Teeth may be set about 8 inches away from the row. A new shovel is available that has a vertical flange to throw soil to the row more effectively without cultivating either closely or deeply.

The question is often asked whether cultivation will conserve soil moisture. Research shows that cultivation does not prevent the loss of soil moisture from the surface. It may, however, help in two ways. First it kills weeds which use water more rapidly and to a greater depth than will be lost by evaporation. Second, cultivation often breaks a surface crust and thus allows rainfall to move more rapidly into the surface. The result is that more rainfall enters the soil and is available for the corn.

HARVESTING AND STORING

SILAGE

In choosing the best time to harvest corn for silage the farmer must strike the proper balance of yield, keeping quality, feeding value, and the risk of frost or wet soils that would make harvesting difficult.

YIELD. The yield of silage continues to increase at least until the last week or two before the grain is fully mature. Toward the end of the growing period, some stored material moves into the grain from the plant tissues in the ear region, but the total dry weight of the plant increases until very near the end of grain development. The highest green weight is reached about 4 weeks before the highest dry weight (figure 17) and this deceives many people. They judge silage by green weight, but dry weight more nearly represents feeding value. A 10-acre field developing from the late milk to hard dough stage is adding about 17 bushels of grain each day. Most New York farmers purchase grain. Extra grain in well-developed silage can replace purchased grain.

KEEPING QUALITY. For safe storage, silage should contain about 70 percent moisture. If it is too dry it won't pack tightly enough to prevent mold growth. Mold must have air to grow. A small amount of moldy silage won't hurt cattle, but its palatability may be lower and most farmers discard it. In the process of growing, mold consumes part of the feeding value of the silage. If silage gets slightly too mature to keep well, it should be chopped extra fine to promote close packing. Extra care should be taken in moving the distributor pipe to give even filling and to prevent the light, dry pieces from settling in one place. Water may be added but it is difficult to know how much to add. The amount is greater than most persons expect. To raise *one ton* of silage from 60 percent moisture to the desired 70 percent takes about 266 pounds or 33 gallons of water.

The best silage stage is when the grain is nearly fully dented (figure 38) *and the kernels are firm, not soft or milky. The early dent stage is far too early to make silage.* The grain is no more than one-half developed (figure 20). Many farmers worry about well-developed kernels passing through the digestive system of cattle without being digested. A 30-pound feeding of well-eared silage corn should contain at least 3 pounds of grain with about 2,000 kernels in each pound, or a total of 6,000 kernels. A few whole kernels of corn in the manure should be no cause for concern. When corn was cut with a binder and left on the ground to dry for several hours, it was necessary to cut at an early stage of growth in order to assure enough moisture to keep well. A field chopper allows a farmer to delay filling for two reasons. First, the crop is taken directly from the standing stalk to the silo with no chance for drying. Second, the crop can be ensiled more rapidly in case of an unexpected early frost.

Frosted corn should be ensiled as soon as possible. The leaves are killed and they soon dry enough to break off in handling. Also, the dead leaves do not pack well; poor packing favors mold growth which, in turn, causes higher losses in dry matter and poor quality silage. In a year when corn growth is delayed

Figure 38. The ear on the left shows nearly fully dented kernels and is the best silage stage. The kernels are firm, not soft or milky.

by late planting or a cool growing season, the farmer has to decide whether to fill the silo on the usual date or allow the crop to grow and risk a frost. Since the leaves make up only 10 to 12 percent of the total dry weight (figures 18 and 19) losing part of them after a frost is likely to result in less loss than the certain loss of grain from cutting too soon. Many more New York farmers cut silage too early than too late.

EAR CORN SILAGE. Ensiling the ears of corn that were killed by an early frost has been reported in several states as a suitable means for salvaging a soft corn crop. A research study was initiated under R. B. Musgrave at Cornell in 1956 to find whether ear corn silage had a place on some farms of the state not only as an emergency measure but as a regular practice.

With minor adjustments in corn pickers (removing the husking rolls on some models) the ears are snapped when the moisture is 40 to 50 percent in the *ear as a whole* which corresponds roughly to 35 to 45 percent moisture in the *grain*. If further research verifies early results that the ear silage will preserve satisfactorily at this low moisture level, it will be possible to allow the crop to reach more than 90 percent of its full possible grain yield (perhaps 95 to 98 percent). In that case ear corn silage should be very attractive to many farmers for several reasons:

1. They could grow a "full season" hybrid for their elevation and latitude without the risk of a "soft corn" crop.
2. Those who are on the borderline of having a long enough effective growing season for grain corn could grow a crop that is roughly equal to oats in feeding value on a dry basis.
3. The typical 7 to 10 percent loss with the corn picker on mature grain is largely avoided. Careful studies show that under good picking conditions losses from missed ears and shelled corn are about 7 to 10 percent.
4. Part, in some fields most, of the loss due to stalk rot would be avoided. Under farm conditions the main loss from stalk rot is from lodged plants. The corn picker misses the ears. Lodging occurs after the ears are mature but before they are dry enough to store easily.
5. Ear corn silage requires only one-half as much silo space as regular silage.
6. Ear corn silage is the best method to salvage "soft corn" after an early killing frost.

Since ear corn silage is a more valuable product than ordinary silage, special measures should be taken to prevent top spoilage. Plastic silo covers accomplish this objective at a reasonable cost.

GRAIN

Corn grain is mature when it averages 35 percent moisture (figure 20). The rate at which it dries in the field after maturity depends upon the weather. It averages about ½ percent each day in New York but likely varies from 0 to nearly 1 percent.

HARVESTING. Most grain corn in New York is harvested with corn pickers. Corn hybrids differ in ease of husking. Some high-yielding hybrids have been discredited because of hard husking. This is unfortunate because in many cases the difficulty could have been partly overcome by careful adjustment of the corn picker. Persons who operate custom pickers object vigorously to such hybrids, but the grower would be money ahead to pay a slight extra picking charge rather than to shift to a lower-yielding hybrid.

Picker-shellers have been used to a small extent since about 1954. About 1955 or 1956 a few farmers began to harvest with combines equipped with corn attachments. The shelled corn from a picker-sheller or combine must be dried with heated air since the safe moisture for storage is near 15 percent, and corn never reaches that level in the field in New York.

STORING. Research by the Departments of Agronomy, Agricultural Engineering, and Plant Breeding at Cornell between 1952 and 1956 showed that corn could be safely stored in 4½-foot cribs (figure 39) at 35 percent moisture in the grain. This is somewhat higher than was previously thought possible. There would likely be some mold in corn stored at this moisture content in years with unusually warm, wet falls. The cribs 8 to 10 feet in diameter without center ventilation, which are typical of the midwest, are not suited to New York because the corn normally is higher in moisture here.

Screening out shelled corn and broken cobs as the crib is filled is desirable because they interfere with free movement of air through the ear corn and thus are likely to increase mold damage.

If the corn crop matures early, the fall weather is favorable for drying, and there is little stalk rot, corn may dry to 20 to 25 percent moisture in the field. Where examination in the field shows that stalk rot is prevalent, it is desirable to pick early before the plants lodge and then to store with special care to avoid mold development or to dry with forced air.

MARKETING. New York farmers who sell cash corn do not get the Chicago price plus freight and handling. In other words, they fail to get the full advantage of their nearness to the consuming area. The two most important reasons seem to be: (1) they often sell in the fall when the market is flooded and (2) they do not deliver a uniform product. Much of the corn is high in moisture and must be dried with heat before it can be stored in the elevator or ground into feed.

If the trend continues toward larger acreages on a few farms that are well equipped to produce good quality grain corn, possibly with farm driers, the farmers of the state should receive a more favorable price relative to midwest prices.

When corn is sold by a farmer to his neighbor, the buyer and seller have difficulty in arriving at a fair price. The data in figure 21 can serve as a guide since it shows the amount of corn at various moisture levels that is required to equal a standard bushel.

Figure 39. Experimental cribs used in storage experiments. Ear corn with moisture contents up to 35 per cent were safely stored.

NOTES

NOTES

Cooperative Extension Service, New York State College of Agriculture at Cornell University and the U. S. Department of Agriculture cooperating. In furtherance of Acts of Congress May 8, June 30, 1914. M. C. Bond, Director of Extension, Ithaca, New York.